ATTACHMENT B: Calculation of IEUBK Model and Adult Lead Methodology (ALM) Absorption Fraction Parameter from IVBA Results of EPA Method 1340

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The Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK model) allows the user to specify a site-specific value for the parameter absorption fraction percent for soil lead (AFP_{soil}). This value is entered in the *GI Values/Bioavailability Information* menu (*GI/Bio*) of the IEUBK model (Figure B-1). The value for AFP_{soil} can be estimated from *in vitro* bioaccessibility (IVBA) of site soil samples measured using U.S. Environmental Protection Agency (U.S. EPA) Method 1340, which provides predictions of relative bioavailability (RBA). The procedure for converting IVBA into AFP_{soil} is described below.

The initial step in the process is to convert laboratory data on IVBA to corresponding values for RBA by applying the Method 1340 regression model relating RBA and IVBA. The exact calculation to be used will depend on the data that will be generated by the laboratory that runs Method 1340. The resulting value for RBA to be assumed in the risk assessment is then converted to a corresponding value for AFP_{soil} in the IEUBK model.

Four cases of different presentations of laboratory IVBA data are presented below.

(1) If the laboratory reports IVBA as a fraction, rather than as a percent, then the calculation of AFP_{soil} is as follows:

$$RBA\ fraction = IVBA\ fraction \times 0.878 - 0.028 \qquad \text{Eq. (B-1a)}$$

$$AFP_{soil} = RBA\ fraction \times AFP_{water} \qquad \text{Eq. (B-1b)}$$

where RBA is expressed as a fraction; 0.878 and 0.028 are the regression slope and intercept, respectively, for the relationship (linear regression) between IVBA and RBA for lead in soil; and the absorption fraction percent of lead in drinking water (AFP_{water}) is the default value (50%) from the IEUBK model for soluble lead.

(2) If the laboratory reports IVBA in units of percent, then the calculation of AFP_{soil} is as follows:

$$RBA\ fraction = IVBA\ percent/100 \times 0.878 - 0.028 \qquad \text{Eq. (B-2b)}$$

$$AFP_{soil} = RBA\ fraction \times AFP_{water} \qquad \text{Eq. (B-2b)}$$

(3) If the laboratory reports RBA rather than IVBA, and reports RBA as a fraction, then the calculation of AFP_{soil} is as follows:

$$AFP_{soil} = RBA\ fraction \times AFP_{water} \qquad \text{Eq. (B-3)}$$

(4) If the laboratory reports RBA rather than IVBA, and reports RBA as a percent, then the calculation of AFP_{soil} is as follows:

$$AFP_{soil} = RBA\ percent/100 \times AFP_{water} \qquad \text{Eq. (B-4)}$$

Examples:

	Equations	Measured IVBA	Predicted RBA	IEUBK Absorption Fraction Percent
Case 1	B-1a,b	0.45	0.37	18%
Case 2	B-2a,b	50%	0.41	21%
Case 3	B-3	--	60%	30%
Case 4	B-4	--	0.50	25%

The corresponding absorption parameter in the ALM is the absorption fraction for soil and dust (AF_{S+D}), which sets the value for the fraction of ingested soil lead that is absorbed into blood (equivalent to soil lead ABA). The default value for AF_{S+D} in the ALM is 0.12 (12%), which was based on an RBA for soil lead of 60% and an absorption fraction for soluble lead in adults of 20% (i.e., 12/20 = 0.6; U.S. EPA, 2003c). A site-specific value for AF_{S+D} can be calculated from measurements of soil RBA as follows:

$$AF_{S+D} = RBA\% / 100 \times 0.20$$

Examples:

	Equations	Measured IVBA	Predicted RBA	ALM Absorption Fraction
Case 1	B-1a,b	0.45	0.37	7.4%
Case 2	B-2a,b	50%	0.41	8.2%
Case 3	B-3	--	60%	12%
Case 4	B-4	--	0.50	10%

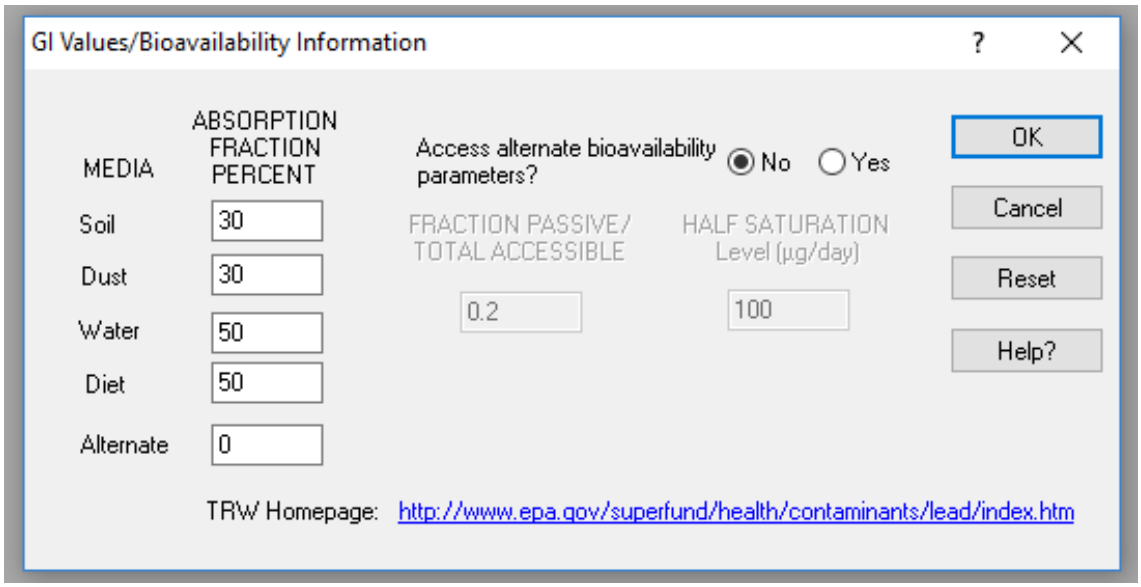

Figure B-1. Default Parameters for Absorption Fraction Percent in the IEUBK Model.

Reference:

U.S. EPA (U.S. Environmental Protection Agency). (2003c) Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. EPA-540-R-03-001, OSWER Directive #9385.7-54. December. Available online at: https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals.